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A Conservation Tillage Practice That Resists Compaction

Uncontrolled field traffic can cause hardpan formation which restricts root growth, thus reducing plant productivity. But cooperative AAES- U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS) research indicates that using an in-row subsoiler in a conservation tillage practice can help avert soil compaction immediately beneath the row.

An experiment was conducted at the E.V. Smith Research Center, Shorter, to determine the effects of tillage and traffic treatments on physical condition of soil. For the study, intensive soil sampling was conducted at the conclusion of a five year wheat-cotton double cropping system.

A special research vehicle, the USDA-ARS Wide Frame Tractive Vehicle (WFTV), was used as a platform to conduct all operations. This vehicle allows for a 20-foot cropping zone (eight 30-inch rows) that can be kept free of traffic by farm equipment. A tractor was driven on plots designated for traffic to simulate equipment traffic from normal farming operations on both wheat and cotton.

Several different tillage treatments for cotton were used to determine the interaction of traffic with tillage systems. These treatments included:
(1) CT-SS = conventional tillage with no subsoiling (disk, field cultivate, and plant);
(2) CT+CD = conventional tillage with initial complete hardpan disruption (disk, field cultivate, and plant);
(3) CT+SS = conventional tillage with in-row subsoiling (disk, field cultivate, in-row subsoil, and plant), and;
(4) NT+SS = no-tillage with in-row subsoiling (in-row subsoil and plant).
Each tillage treatment had both traffic and no-traffic treatments.

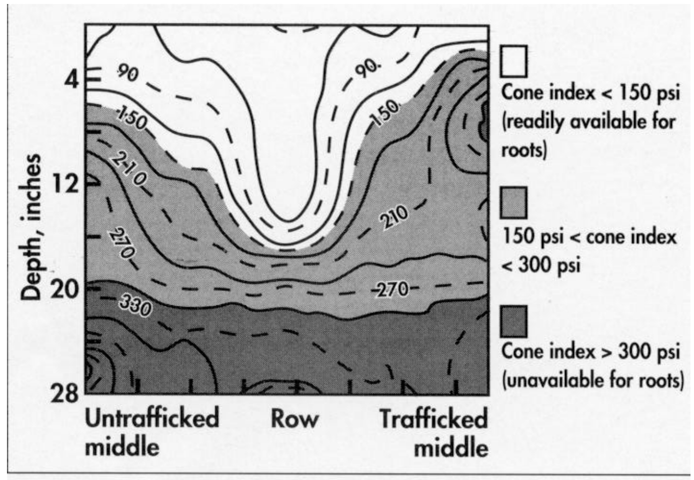
Soil penetrometer readings were used to determine the depth to the hardpan. This measurement is important because it indicates the depth of effective crop rooting.

The soil condition resulting from years of continuous tillage and traction research provided vital information about the damaging effects of traffic on soil that was conventionally fanned. In the conventional farming system without any deep tillage (CT-SS), traffic caused the depth to the hardpan to decrease by almost 22% and the cotton lint yield to decrease more than 14% (see table).

In the tillage treatment that was completely disrupted with a V-frame subsoiler at the beginning of the five-year study (CT+CD) traffic caused the depth to the hardpan to decrease by 35% and cotton lint yield to decrease by 14%. The benefits of complete disruption disappeared and this was the poorest yielding tillage treatment when traffic was not controlled.

When an in-row subsoiler was used with conventional tillage (CT+SS), traffic did not affect the depth to the hardpan, but decreased cotton lint yield by almost 9%.

With the NT+SS treatment, traffic actually had a positive effect providing a cotton yield increase of 2%. These plots were the most productive and had maximum yields of any in this experiment. Traffic negatively affected the depth to the hardpan slightly, but this was less than 5%. One reason that traffic was not detrimental in the NT+SS treatment was that the soil structure was able to support the applied traffic loads and withstand the damaging effects of traffic. This is illustrated in the contour plot that shows a profile of the crop row and traffic path for tillage treatment NT+SS subjected to traffic (see figure). Even though traffic did compact the soil beneath the row middle, the in-row subsoiler provided adequate rooting depth beneath the row.



Cone index contours for the NT + SS tillage treatment when traffic is applied to row middles.

This experiment indicated that in conventional tillage systems that did not include an in-row subsoiler, traffic negatively affected both the depth to the hardpan and crop yields. However, when the conservation tillage practice of in-row subsoiling was used, the resulting soil structure allowed the soil to withstand the detrimental effects of traffic. Though farmers don't have WFTVs, they can control the negative effects of traffic and maintain surface residue cover by combining conservation tillage with an in-row subsoiler.

Depth to Hardpan and 1991 Cotton Lint Yield as Affected by Traffic and Tillage Treatments

Treatments	Depth to hardpan	Cotton lint yield
	In.	*Lb./a.*
No Traffic		
CT-SS	9.1	955
CT+CD	11.0	912
CT+SS	14.6	872
NT+SS	16.9	957
Traffic		
CT-SS	7.1	815
CT+CD	7.1	786
CT+SS	14.6	794
NT+SS	16.1	978

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